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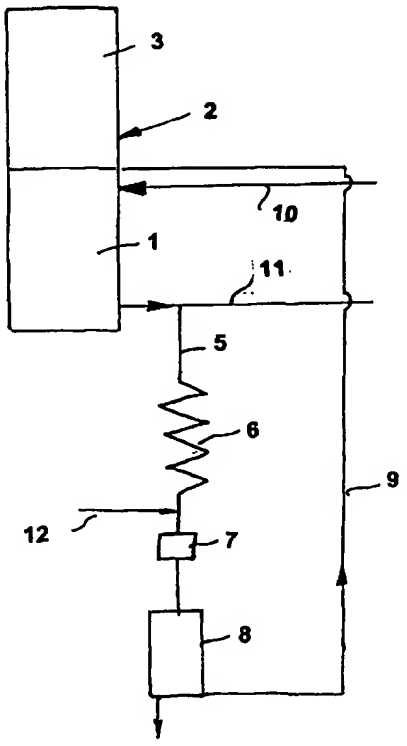
(54) Title: METHOD FOR OPERATING A SUBMARINE, ROTATING DEVICE AND AN APPARATUS FOR SAID DEVICE



(57) Abstract: Gas separated from the outlet (11) from a subsea compressor (1) is cooled utilising the Joule-Thomson effect before it is passed to the gas-filled electric drive motor (2) of the compressor (1). This ensures that there is dry gas in the motor (2) under all the conditions that will be encountered in the subsea station.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Method for operating a submarine, rotating device and an apparatus for said device

The invention relates to a method as disclosed in the preamble of the independent method claim. The invention also relates to an arrangement as disclosed in the preamble of the independent apparatus claim.

The gas-filled electric motor must be kept as dry as possible to avoid corrosion as a result of the reaction between water and hydrogen sulphide and dilution of the lubricant with hydrocarbon condensate. These problems have been discussed in other documents including NO 172075 and NO 173197, which describe respectively the use of a suitable dry foreign gas that is fed to the common pressure shell of a compressor and an electromotor, and the use of a part of the gas pressurised in a compressor as seal gas passed to the seals of the compressor and the gas atmosphere of the electromotor, with cooling of this branched-off gas en route to the device consisting of a compressor and its electromotor.

The object of the present invention is to improve the last-mentioned, known method outlined above by ensuring that a cooled gas is provided which will remain dry during the subsequent heating in the device or motor, under all conditions and especially also during shutdowns and long-term stoppages (dew point control). During such stoppages the gas in the motor may be cooled to the seawater temperature, which typically can be in the range of +10° to -2°C.

The known cooling during heat exchange with the surrounding seawater is, according to the invention, followed by a further cooling using the known Joule-Thomson effect. During the heat exchange with the seawater, the branched-off gas is cooled to about 30°C, above the hydrate temperature, and during the subsequent throttling utilising the Joule-Thomson effect the gas temperature is brought down to zero and lower, for example minus 5°C. A cold gas of this kind will behave like a dry gas under all the conditions that will be encountered in the subsea station.

According to the invention there is therefore proposed a method and an arrangement as defined in the independent claims.

The invention will be described in more detail with reference to the schematic drawing, which shows arrangement according to the invention.

The drawing shows a subsea station having a rotating device 1, for example, a compressor or a wet gas compressor, arranged in a common pressure shell 2 with an electromotor 3. For more details, reference is made to the aforementioned NO patents, although the invention is of course not limited specifically to such embodiments. The pressure shell 2 is supplied with dry gas from a circuit 4 comprising a line 5 which branches off from the outlet 11 of the device 1. The line 5 runs to a heat exchanger 6, where the gas branched off through the line 5 is cooled in heat exchange with the surrounding seawater. After the cooler 6 there follows a throttle 7, where the already cooled gas is cooled further utilising the known Joule-Thomson effect. After the throttle 7 there follows a scrubber 8, i.e., a cyclone, a filter, a precipitation chamber or the like, where as much liquid as possible is separated and removed from the cooled gas. From the scrubber 8 there runs a line 9 to the pressure shell 2.

The hydrocarbon stream may, for example, have a pressure of 50 bar at the inlet 10 and a pressure of 100 bar at the outlet 11. The pressure is reduced to 60 bar in the throttle 7. In the cooler 6 the gas temperature is reduced to about 30°C, i.e., above hydration temperature, and after the throttle the gas has a temperature close to minus 5°C. After the scrubbing in the scrubber 8, there will be a dry gas which will remain dry under all conditions, even during shutdowns and stoppages, provided that the scrubber is of some known type that removes water and hydrocarbon liquid in an effective manner.
An optional injection 12 of a hydrate inhibitor is indicated upstream of the scrubber 8.

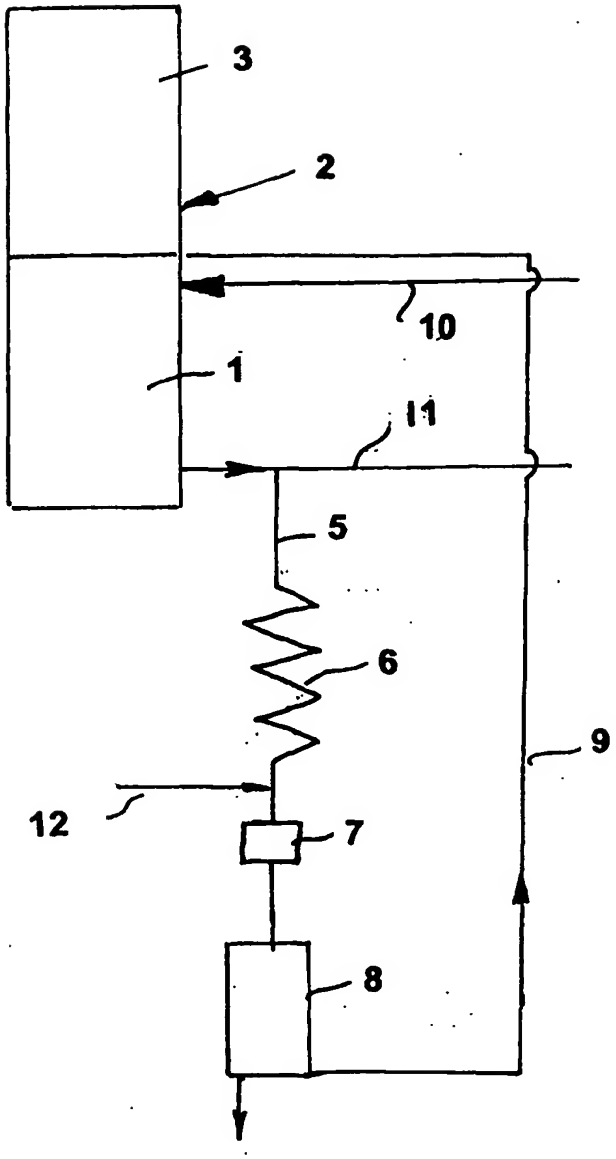
Patent claims

1.
A method for the operation of a subsea, rotating device for applying energy to a hydrocarbon stream, which device has an inlet and an outlet and is driven by a gas-filled electric motor whose gas atmosphere is supplied with gas that is separated from said outlet, cooled in heat exchange with surrounding seawater and scrubbed, characterised in that the separated and cooled gas prior to the scrubbing is throttled utilising the Joule-Thomson effect.

2.
A method according to claim 1, characterised in that a hydrate inhibitor agent is added upstream of the scrubbing.

3.
An arrangement for a subsea, rotating device (1) for applying energy to a hydrocarbon stream, which device (1) has an inlet (10) and an outlet (11) for the hydrocarbon gas stream and is driven by a gas-filled electric motor (3), the gas atmosphere of the motor (3) being supplied with gas that is separated from said outlet (11), cooled in a heat exchanger (6) against the surrounding seawater and scrubbed in a scrubber (8), characterised in that between the heat exchanger (6) and the scrubber (8) there is provided a throttle (7) for the separated and, in the heat exchanger (6), cooled gas, which throttle (7) utilises the Joule-Thomson effect.

4.
An arrangement according to claim 3, characterised in that upstream of the scrubber (8) there is provided an injection device (12) for injecting a hydrate inhibitor into the separated gas.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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B01D 53/26, E21B 43/01, F04D 29/10 // F25B 9/02
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	US 5382141 A (STINESSEN), 17 January 1995 (17.01.95), column 2 - column 5, figures 1-2	1-4
A	US 5154741 A (DA COSTA FILHO), 13 October 1992 (13.10.92), whole document	1-4
A	US 3495380 A (G.H. REDMAN ET AL), 17 February 1970 (17.02.70), whole document	1-4

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Inger Löfving / JA A Telephone No. +46 8 782 25 00

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

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30/12/02

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